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The effects of patient triage management strategies on clinical outcomes and risk management in emergency departments: a prospective comparative study

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ABSTRACT

Aims: The aim of this study is to compare the impact of the emergency severity index (ESI) and the Manchester triage system (MTS) on clinical outcomes, patients' satisfaction, and risk management using a prospective approach.

Methods: In this study, which includes 12,000 patients who visited the emergency department of Esenyurt Necmi Kadıoğlu State Hospital between September 1, 2024, 2024, and October 15, 2024, 6,000 patients were triaged using the ESI, and 6,000 patients were triaged using the MTS. The study was conducted by randomly selecting patients between the ages of 18-85 who were visiting the emergency department for the first time. Data were collected using the observations of healthcare personnel, electronic health system data, and patient admission records. The primary variables include treatment times, clinical outcomes, resource utilization in the emergency department, and patient waiting times. Surveys were used to measure patients' satisfaction, and medical inaccuracies were evaluated based on error reports and inconsistencies in medical records. Statistical analyses were performed using SPSS software, applying independent sample t-tests, chi-square tests, and logistic regression analyses.

Results: It was found that patients triaged using the ESI had significantly lower waiting times compared to those triaged using the MTS (OR: 0.65, 95% CI: 0.50-0.85, $p<0.05$). Mortality rates in the ESI group were also significantly lower compared to the MTS group (OR: 0.72, 95% CI: 0.55-0.92, $p<0.05$). In terms of complication rates, patients triaged with ESI also showed a significant reduction compared to those triaged with MTS (OR: 0.60, 95% CI: 0.45-0.80, $p<0.01$). ESI-triaged patients showed a significant improvement in resource utilization compared to patients triaged using MTS (OR: 0.70, 95% CI: 0.55-0.88, $p < 0.05$). Patient satisfaction results also showed a significant difference in favor of ESI (OR: 1.50, 95% CI: 1.25-1.80, $p<0.001$). Medical errors and legal issues were observed to be less frequent among patients triaged with ESI, a finding that was significant in terms of risk management (OR: 0.55, 95% CI: 0.40-0.75, $p<0.05$).

Conclusion: The use of the ESI as a triage method may be an effective approach for reducing medical inaccuracies, mortality, and complication rates, as well as optimizing emergency department management. These findings suggest the need for reviewing triage systems in clinical practice and expanding the use of ESI. I believe that incorporating ESI, a triage method that enhances patients' satisfaction and optimizes resource utilization, into future emergency department management is crucial.

Keywords: Emergency severity index, Manchester triage system, clinical outcomes, risk management, patient satisfaction, medical error

INTRODUCTION

In recent years, the increasing demand for healthcare services, driven by population growth and easier access to healthcare, has also been reflected in emergency departments. This situation has led to significant overcrowding and increasing pressure on healthcare institutions.[1,2] Among healthcare service providers, emergency departments are one of the most dynamic and busiest areas of the healthcare system, requiring the rapid and effective management of patients using limited resources. Timely, swift, and appropriate evaluation of patients in emergency departments is essential for both patient safety and the efficient use of healthcare services. This, in turn, improves the efficiency and quality of healthcare services.

The growing patient volume in emergency departments significantly affects both the quality of care and the workload, along with the use of resources. Triage systems have been developed to manage the impact of overcrowding and ensure the efficient use of resources in emergency departments.[3] These systems contribute significantly to improving the efficiency of limited resources in emergency departments by enabling the rapid assessment of patients and prioritizing

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those who require urgent intervention. The effective use of triage systems not only ensures that patients in need of urgent intervention are treated quickly but also shortens waiting times in the emergency department, thereby contributing to increased patients' satisfaction.[4]

Two widely used triage systems are the emergency severity index (ESI) and the Manchester triage system (MTS). The ESI, which categorizes patients into five levels based on the urgency of their condition, is one of the most commonly used triage systems in the United States.[5] The primary goal of the ESI is to quickly assess patients to ensure timely critical interventions.[6] One of the key advantages of the ESI is that it supports rapid decision-making processes, thereby contributing to the reduction of mortality and morbidity rates.[7] However, the ESI may be insufficient in cases where symptoms are complex.[8]

In the MTS, which is widely used in many European countries and the UK, patients are categorized by color codes based on their symptoms.[9] Waiting and treatment times are determined according to these color codes. Classifying patients based on their clinical symptoms facilitates the decision-making process for healthcare personnel, which gives MTS a significant advantage. However, evaluating patients with complex symptoms may take longer and cause difficulties, especially in busy emergency departments.[10]

When evaluated in terms of patients' satisfaction, medical error rates, patient outcomes, resource utilization, and waiting times, these two triage systems can produce different results. Comparing the impact of these two systems on clinical outcomes and risk management can provide significant contributions to developing more effective triage systems.

This study, conducted with 12,000 patients who visited Esenyurt Necmi Kadıoğlu State Hospital between October 1, 2024, and November 1, 2024, used the ESI and the Manchester MTS as triage systems. The study compares the impact of the triage process on clinical outcomes and risk management using a prospective approach. The ESI was applied to 6.000 patients, while the MTS was applied to the other 6.000 patients. In this analysis, the impact of both triage systems on patient waiting times, clinical outcomes (mortality and complication rates), resource utilization in the healthcare system, patients' satisfaction, and the reduction of medical inaccuracies were examined in detail.

This study, which aims to provide important insights into the development of triage management systems, shows that the data obtained from the comparative analysis of triage methods can improve the quality of healthcare services. The findings of this study may offer valuable insights for enhancing risk management in healthcare institutions and ensuring patient safety.

METHODS

The study was conducted with the permission of the Ethics Committee of İstanbul Medipol University Non-interventional Clinical Researches Ethics Committee (Date: 12.09.2024, Decision No: 898). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This prospective and comparative study was conducted with 12,000 patients who visited the emergency department of Esenyurt Necmi Kadıoğlu State Hospital between September 1, 2024, and October 15, 2024, with random patient inclusion. The ESI was applied to 6,000 patients, while the MTS was applied to the remaining 6.000. Data were collected from patient admission records, healthcare personnel observations, and electronic health system records.

In this comparative study, patients were closely monitored to determine whether they required immediate intervention. During their treatment in the emergency department, the frequency of emergency interventions, patient waiting times, complications, mortality rates, and hospital admission rates were systematically recorded. Resource utilization in the hospital, patients' satisfaction, and medical error rates were used to assess the effectiveness of the triage processes.

Patients were randomly selected from those who visited the emergency department during the study period. The study included first-time emergency department patients aged 18-85. Triage was performed using either the ESI or MTS. Detailed data were collected on the patients' age, gender, vital signs, medical history, clinical and demographic data, current clinical condition, and reason for admission. Patients were classified according to age groups, which were considered in the statistical analyses. Clinical evaluations were performed following the protocols of the respective triage systems.

Patients excluded from the study were those under 18 years of age, patients who made multiple visits during the study period, pregnant patients, those with insufficient clinical data at the time of admission, patients transferred to other facilities after stabilization, and those requiring psychiatric evaluation during their emergency visit.

Patient complaints, vital signs, demographic data, laboratory results, imaging results, and clinical evaluations conducted during triage were recorded in the electronic patient record system. Data collection was based on patient records and healthcare personnel observations. Special attention was given to analyzing age groups to thoroughly examine the impact of each triage system on clinical outcomes.

Throughout the study, patient privacy and data security were maintained, with access to the data restricted to authorized personnel. The data were anonymized to ensure confidentiality, while ensuring compliance with ethical standards in data management.

The primary variables were clinical outcomes (mortality and complications), patient waiting times, resource utilization in the emergency department, and treatment times. These primary variables were thoroughly examined to understand the impact of the two triage systems on emergency department processes and patient outcomes.

Potential legal issues, medical error rates, and patients' satisfaction were secondary variables. Patient satisfaction was assessed through surveys conducted after discharge, rated on a scale from 1 to 10. Medical errors were evaluated based on errors reported during triage and inconsistencies in medical records. Legal issues arising from triage, including medical

lawsuits and legal processes, were analyzed through the related data.

The differences between the ESI and MTS in terms of clinical outcomes and risk management were comprehensively assessed using these measurements.

Efforts were made to minimize subjectivity, in the satisfaction survey data by using questions and anonymous survey collection methods. Furthermore the analysis considered factors like response bias and variations, in expectations that can affect data.

For resource utilization, hospital billing and accounting records were reviewed. Billing data from all procedures, materials used, and treatments administered in the emergency department were collected, and the average cost per procedure was calculated. The costs of medications and equipment used during the triage process were obtained from the electronic health records (EHR). A total cost analysis was performed by combining the costs of procedures, medications, materials, and personnel to calculate the average cost for patients triaged by each method. This comprehensive analysis assessed the financial impact of emergency department triage management strategies on resource utilization.

Statistical Analysis

The data were analyzed using SPSS 28.0 statistical software. The Kolmogorov-Smirnov test was used to check the normal distribution of the data. Continuous variables such as clinical outcomes, patients' satisfaction, resource utilization, and waiting times were examined using independent sample t-tests. The chi-square test was used for categorical variables. Logistic regression analysis was performed to further investigate critical outcomes, including complications, mortality rates, and triage accuracy.

Additionally, medical error rates and legal issues were assessed based on healthcare personnel feedback and analysis of legal records as part of risk management. A p-value of <0.05 was considered statistically significant in all analyses.

RESULTS

This study included 1.189 patients aged 18-25, 1.849 patients aged 26-35, 1.749 patients aged 36-45, 1.736 patients aged 46-55, 1.703 patients aged 56-65, 1.821 patients aged 66-75, and 1.773 patients aged 76-85 (**Figure 1, Table 1**).

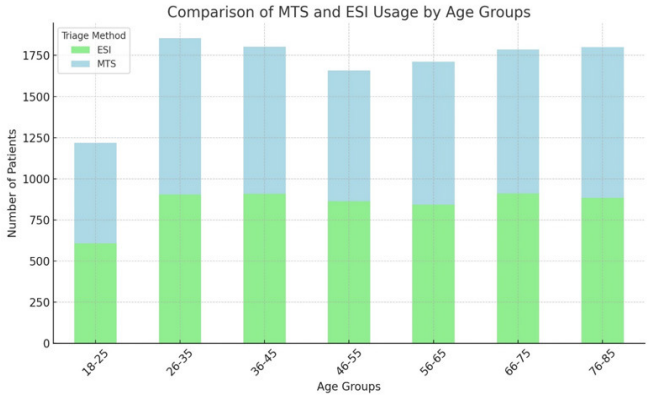

Figure 1. Comparison of Manchester triage system and emergency severity index usage by age groups

Table 1. Patient distribution by age group

Age group	Number of patients
18-25	1189
26-35	1849
36-45	1749
46-55	1736
56-65	1703
66-75	1821
76-85	1773

Of the patients participating in the study, 6,008 were male, and 5.992 were female (**Figure 2, Table 2**).

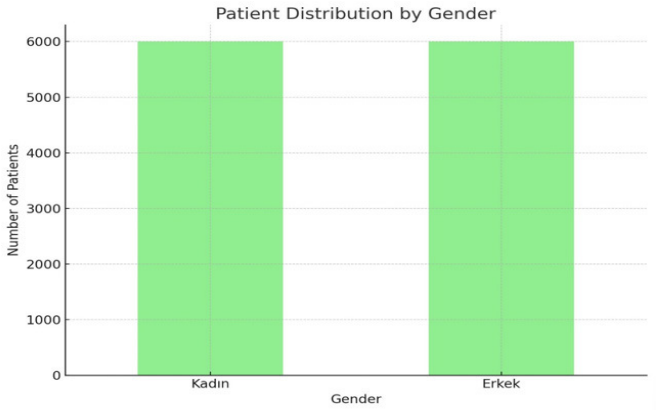

Figure 2. Patient distribution by gender

Table 2. Patient distribution by gender

Gender	Number of patients
Male	6008
Female	5992

When comparing the ESI and the MTS in terms of risk management, the ESI group consisted of 6,000 patients, of whom 4,164 (69.5%) were categorized as having "Good" risk management, 1.210 (20.2%) as having "Moderate" risk management, and 626 (10.4%) as having "Poor" risk management (**Figure 3, Table 3**).

In the MTS group of 6.000 patients, 2.377 (47.5%) were categorized as having "Good" risk management, 2,392 (47.8%) as having "Moderate" risk management, and 1,231 (24.7%) as having "Poor" risk management (**Figure 3, Table 3**).

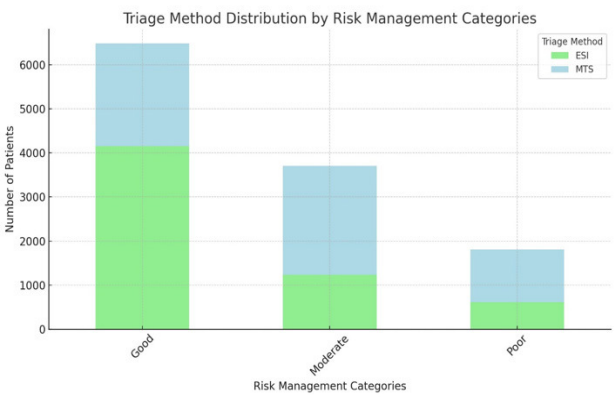

Figure 3. Triage method distribution by risk management categories

The results show that patients triaged using the ESI had a higher rate of "Good" risk management (69.5%), whereas those triaged using the MTS had higher rates of "Moderate" (47.8%) and "Poor" (24.7%) risk management (**Figure 3, Table 3**).

Table 3. Distribution of ESI and MTS triage methods by risk management categories

Triage method	Good	Moderate	Poor
ESI	4164	1210	622
MTS	2377	2392	1237

ESI: Emergency severity index, MTS: Manchester triage system

In the ESI group of 6.000 patients, 59 (0.95%) died, 320 (5.27%) were admitted to the intensive care unit (ICU), and 5.621 (93.78%) recovered. In the MTS group of 6.000 patients, 170 (2.86%) died, 600 (9.99%) were admitted to the ICU, and 5.230 (87.15%) recovered. These results indicate that the ESI provided better clinical outcomes compared to the MTS. The recovery rate was higher, and the rates of death and ICU admission were lower in the ESI group than in the MTS group (**Figure 4, Table 4**).

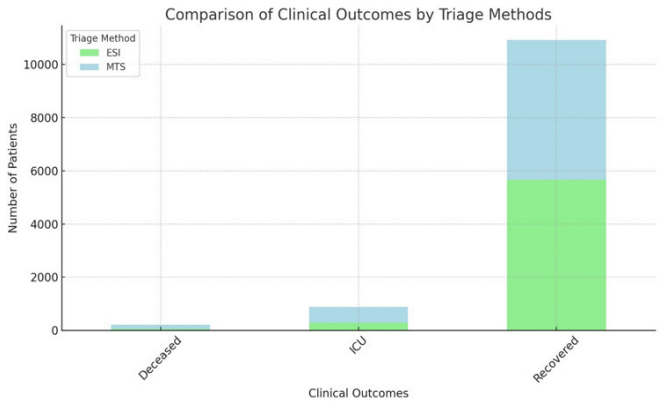

Figure 4. Comparison of clinical outcomes by triage methods

Table 4. Clinical outcomes analysis

Triage method	Deceased patient	ICU	Recovered patient
ESI	59	320	5621
MTS	170	600	5230

ESI: Emergency severity index, MTS: Manchester triage system, ICU: Number of intensive care patients

The average satisfaction score for the 6,000 patients triaged using the ESI was 8.25, meaning that 82.5% of patients were satisfied. Meanwhile, the average satisfaction score for the 6.000 patients triaged using the MTS was 7.15, with 71.5% patients' satisfaction. The difference in average satisfaction scores between the two methods was 1.10 points, showing that the ESI had a more positive impact on patients' satisfaction than the MTS (**Table 5, Figure 5**).

Table 5. Patient satisfaction analysis

Triage method	Number of patients	ASP	SR%
ESI	6000	8.25	82.5
MTS	6000	7.15	71.5

ESI: Emergency severity index, MTS: Manchester triage system, ASP: Average satisfaction score, SR: Satisfaction rate

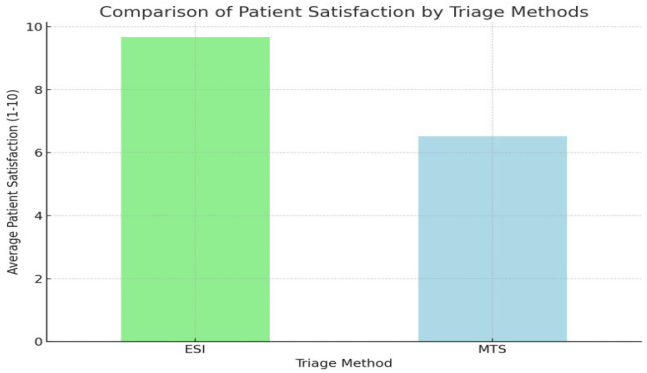

Figure 5. Comparison of patient satisfaction by triage methods

In the ESI group of 6,000 patients, 298 (4.97%) developed complications, while in the MTS group, 715 (11.90%) developed complications. These results show that the ESI posed a lower risk of complications compared to the MTS (**Figure 6, Table 6**).

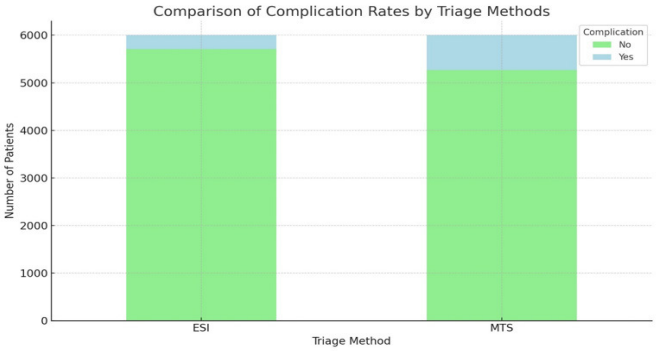

Figure 6. Comparison of complcation rates by triage methods

Table 6 . Complication rate analysis

Triage method	Number of patients	Number of complications	Complication rate %
ASİ	6000	298	4.97
MTS	6000	715	11.9

ESI: Emergency severity index, MTS: Manchester triage system

In the ESI group, 122 out of 6.000 patients (2.04%) experienced mortality, while in the MTS group, 328 out of 6.000 patients (5.46%) experienced mortality. These results indicate that the ESI carries a lower risk of mortality compared to the MTS (**Figure 7, Table 7**).

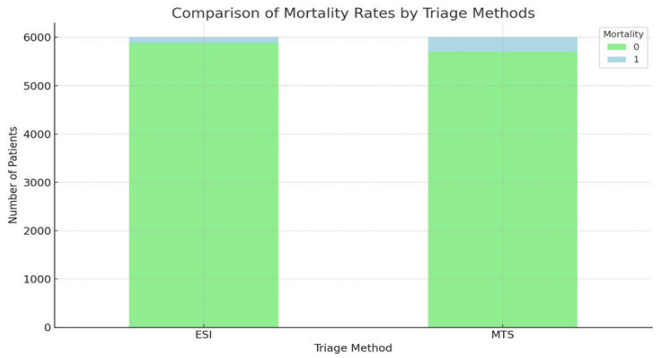

Figure 7. Comparison of mortality rates by triage methods

Table 7. Mortality rate analysis

Triage method	Number of patients	Number of mortalities	Mortality rate %
ASİ	6000	122	2.04
MTS	6000	328	5.46

ESI: Emergency severity index, MTS: Manchester triage system

The waiting time of 6,000 patients triaged using the ESI was analyzed. The average waiting time was found to be 20.05 minutes, with a standard deviation of 4.01 minutes. The shortest waiting time was 4.59 minutes, and the longest was 35.24 minutes. Twenty-five percent of patients waited less than 17.40 minutes, 50% waited less than 19.99 minutes (median), and 75% waited less than 22.72 minutes (**Figure 8, Table 8**).

For the MTS group of 6,000 patients, the average waiting time was 44.87 minutes, with a standard deviation of 10.17 minutes. The shortest waiting time was 8.65 minutes, and the longest was 81.90 minutes. Twenty-five percent of patients waited less than 37.92 minutes, 50% waited less than 44.96 minutes (median), and 75% waited less than 51.50 minutes (**Figure 8, Table 8**).

In conclusion, the ESI group exhibited significantly shorter and less variable waiting times compared to the MTS group.

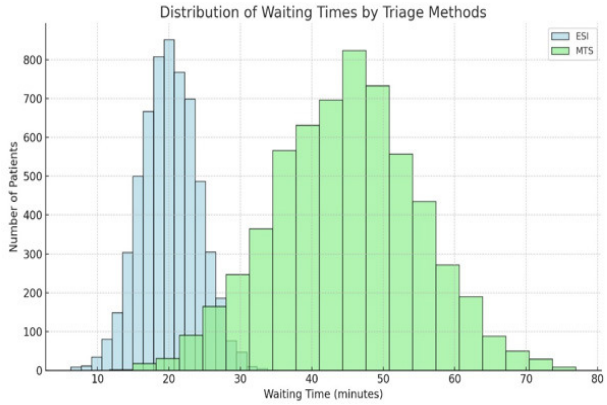

Figure 8. Distribution of waiting times by triage methods

Table 8. Waiting times

Triage method	Number of patients	Average	Standard deviation
ESI	6000	20.04	4.01
MTS	6000	44.8	10.01
Triage method	**Number of patients**	**Shortest waiting time**	**Longest waiting time**
ESI	6000	4.5	35.2
MTS	6000	8.6	81.9

ESI: Emergency severity index, MTS: Manchester triage system

In the ASI triage method, 1.525 patients are in the low resource utilization group, representing 25.42% of the total patients. In the moderate resource utilization group, there are 4.386 patients, accounting for 73.10% of the total. In the high resource utilization group, there are 89 patients, corresponding to a rate of 1.48% (**Figure 9, Table 9**).

In the MTS triage method, 208 patients are in the low resource utilization group, representing 3.47% of the total patients. In the moderate resource utilization group, there are 4.617 patients, accounting for 76.95% of the total. In the high resource utilization group, there are 1.175 patients, corresponding to a rate of 19.58% (**Figure 9, Table 9**).

These results indicate that ASI has higher rates of low and moderate resource utilization compared to MTS, while MTS has a higher rate of high resource utilization than ASI.

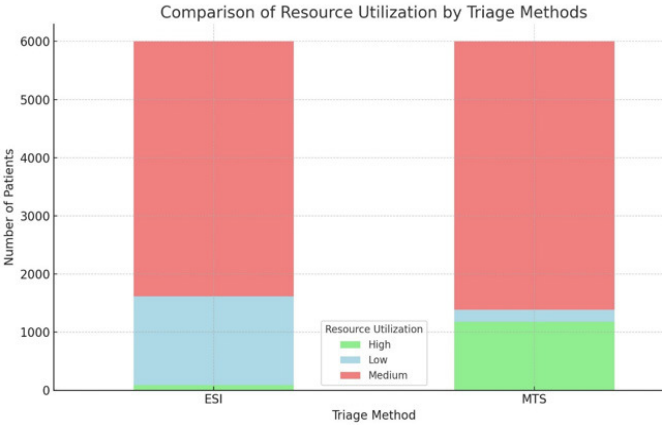

Figure 9. Comparison of resource utilization by triage methods

Table 9. Resource utilization

Triage method	Number of patients	Resource utilization	Resource utilization %
ESI	1525	Low	25.42
MTS	208	Low	3.47
ESI	4386	Medium	73.10
MTS	4617	Medium	76.95
ESI	89	High	1.48
MTS	1175	High	19.58

ESI: Emergency severity index, MTS: Manchester triage system

Among the total of 6.000 patients evaluated using the ASI triage method, medical inaccuracies were identified in 119 patients. This indicates a medical error rate of 1.99% for patients triaged with the ASI method (**Figure 10, Table 10**).

Among the total of 6,000 patients evaluated using the MTS triage method, medical inaccuracies were made in 515 patients. This indicates a medical error rate of 8.57% for patients triaged with the MTS method (**Figure 10, Table 10**).

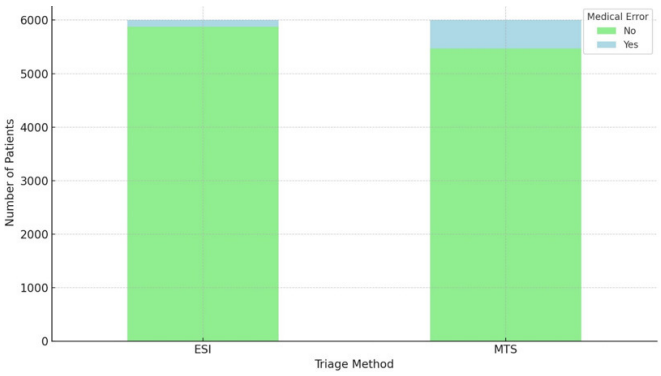

Figure 10. Comparison of medical errors by triage methods

Table 10. Medical error analysis

Triage method	Number of patients	Number of medical errors	Medical error rate %
ESI	6000	119	1.98
MTS	6000	515	8.57

ESI: Emergency severity index, MTS: Manchester triage system

Among the total of 6.000 patients evaluated using the ASI triage method, legal issues were identified in 52 patients. This indicates that 0.87% of patients triaged with the ASI method encountered legal issues (**Figure 11, Table 11**).

Among the total of 6.000 patients triaged using the MTS method, legal issues occurred in 291 patients. This indicates that 4.84% of patients triaged with the MTS method encountered legal issues (**Figure 11, Table 11**).

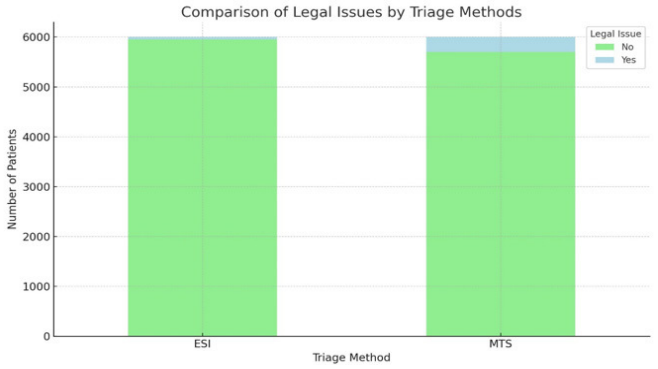

Figure 11. Comparison of legal issues by triage methods

Table 11. Legal issue analysis

Triage method	Number of patients	Number of legal issues	Legal issue rate %
ASİ	6000	52	0.86
MTS	6000	291	4.84

ESI: Emergency severity index, MTS: Manchester triage system

DISCUSSION

This study aimed to compare the impact of two commonly used triage methods in emergency departments -the ESI and the MTS- in terms of risk management, patients' satisfaction, and clinical outcomes. The results showed that the ESI is a superior triage method compared to the MTS. Based on these findings, it is clear that careful consideration should be given when selecting triage methods to manage patient flow in emergency departments, with the ESI emerging as a significant alternative.

This study demonstrated that using the ESI for triage led to shorter waiting times, which in turn reduced mortality and complication rates. This finding highlights the importance of time management in emergency departments and its decisive impact on clinical outcomes. The core of effective patient management in emergency departments is the early and accurate intervention in critical cases. The advantage of the ESI in reducing waiting times makes it a suitable option as an effective triage method in emergency departments.

The ESI, offering a patient-centered and faster evaluation process, proved to be a superior triage method in terms of patients' satisfaction compared to the MTS.[11] It enables patients to be assessed more quickly and accurately. These findings highlight that not only clinical effectiveness but also patients' satisfaction is crucial in the delivery of healthcare services. Given its positive impact on patients' satisfaction,[12] the ESI presents a significant advantage in patient management in emergency departments. This advantage positions the ESI as an important option for triage in emergency departments.

In terms of risk management, the ESI was found to reduce medical error rates and legal issues, as it offers a more systematic and structured approach to triage.[13] Risk management in healthcare is critical for both patient safety and institutional responsibility. By standardizing the decision-making process for healthcare personnel, the ESI reduces the risk of errors.[14] This can be a key factor in choosing the ESI. In reducing medical inaccuracies and complication rates, the ESI also contributes to improved quality of healthcare services.

This study suggests that the ESI is a more effective and efficient triage method in emergency departments. However, similar studies in different populations and healthcare settings are needed to determine the generalizability of these findings. Future research could examine how triage methods perform in various cultural and healthcare systems, contributing to the optimization of triage methods globally.

Limitations

This study has several limitations. First, it was conducted solely at Esenyurt Necmi Kadıoğlu State Hospital, and the findings may not be generalizable to other regions or healthcare institutions. Second, the experience and training level of healthcare personnel could have influenced the results of the triage methods. The success of triage methods depends on how effectively healthcare personnel utilize these systems, and the lack of control over this factor should be considered when interpreting the results.

Additionally, as patients' satisfaction data were collected through surveys, the results may be subject to bias due to the subjective nature of the assessments. Patients' perceptions and expectations regarding the triage process may have influenced the survey results, limiting the accuracy and validity of the patients' satisfaction data.

Future studies should involve larger, multicenter investigations to evaluate the long-term effects of different triage methods on clinical outcomes. Such studies would enable a more comprehensive evaluation of the effectiveness of triage methods across various patient populations and healthcare institutions.

The results of this study indicate that the ESI is an effective tool for managing patient flow in emergency departments, and it is superior to the MTS in terms of clinical outcomes, patients' satisfaction, and risk management. However, to improve the efficiency and effectiveness of triage methods and optimize patient safety, these triage systems should be adapted according to local conditions and the competence levels of healthcare personnel. Additionally, triage methods should be regularly reviewed and updated.

The findings suggest that the ESI could be a more efficient triage method in emergency departments with high patient volumes. However, it is important to note that the MTS may still be a valid and reliable option for certain patient groups. In this context, healthcare institutions should consider factors such as patient population characteristics, emergency department workload, and available resources when selecting a triage system.

While this study sheds light on various aspects of the ESI and MTS, further research involving larger patient populations and diverse emergency department settings is needed. Studies examining the long-term effects of triage methods on patient outcomes could contribute to more effective decision-making processes in emergency departments and provide new insights for optimizing healthcare services.

It should be noted that secondary variables such as medical error rates and legal issues, which were assessed in this study, were based on hospital records and reports from healthcare personnel. In some cases, incomplete or inaccurate records could have affected the accuracy of the findings. Potential gaps or inconsistencies in such data should be considered in future research.

Level of Expertise, Among Healthcare Staff

The efficiency of triage procedures depends greatly on the expertise and training of healthcare professionals involved in the process. This research did not prioritize examining the level of experience of the personnel. Recognized its influence, on the outcomes. The level of experience plays a role, in determining how quickly and accurately decisions are made during triage and can also affect outcomes. Henceforth it is important for upcoming studies to thoroughly assess the experience levels of staff members and explore how they impact results in detail. In our research project we have acknowledged the existence of this complicating factor. Have analyzed the results considering this aspect.

Generalisability and Multi-Center Study Proposal

Single-center studies have inherent limitations. To test the generalisability of the findings to a broader population, it is recommended that a similar study be conducted as a multi-center investigation. Such studies conducted in different healthcare delivery settings and patient populations would allow for the validation of the current findings and enable a more extensive evaluation of the effectiveness of triage systems. This approach would contribute to a better understanding of how triage systems perform in various cultural and operational contexts.

CONCLUSION

This study prospectively evaluated and compared the impact of two of the most commonly used triage methods in emergency departments- ESI and MTS-on patient management and flow in emergency departments. The findings of the research revealed that the ESI is a more effective triage method than the MTS, especially in emergency departments with high patient volumes, as it reduces waiting times and improves patients' satisfaction. Additionally, the ESI was observed to play a significant role in enabling more efficient use of emergency department resources and reducing medical error rates. Furthermore, in terms of mortality rates and complication management, the ESI showed lower mortality and complication rates compared to the MTS.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the Ethics Committee of İstanbul Medipol University Non-interventional Clinical Researches Ethics Committee (Date: 12.09.2024, Decision No: 898).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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